Doing More With Less: The Catalytic Function of IMF Lending and the Role of Program Size

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Abstract

Financial assistance provided by the International Monetary Fund (IMF) is supposed to unlock other financing, acting as a catalyst for private capital flows. The empirical evidence of the presence of such a catalytic effect has, however, been mixed. This paper shows that a possible explanation for the rather inconclusive empirical evidence to date is the neglect of the size of an IMF program. Applying a novel identification strategy to account for endogenous selection into (large) adjustment programs, and using a comprehensive data set spanning the years 1990-2018, we show that the catalytic effect of IMF financial assistance is weakened - and potentially reversed - if the size of a program exceeds a certain level. We argue that large IMF financial assistance coupled with the IMF's preferred creditor status can lead to a crowding-out of private investors by increasing their loss in the event of default. Our findings add to the debate on the optimal size of Fund-supported programs and can also inform the broader policy discussions on the adequacy of IMF resources.

Keywords: International Monetary Fund, catalysis, capital flows, financial crises

JEL classification: F32, F33, F36, G01, G15.

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1 Introduction

The typical IMF program involves a combination of external financing and adjustment. Financing is intended to smooth adjustment of the balance of payments to various shocks, allowing it to be spread over a longer period of time and helping to avoid disruptive economic adjustment or sovereign default. The Fund sees itself as providing only a small portion of a country's external financing requirements and works on the assumption that its involvement will encourage others to lend:

"[...], IMF programs can help unlock other financing, acting as a catalyst for other lenders. This is because the program can serve as a signal that the country has adopted sound policies, reinforcing policy credibility and increasing investors' confidence."
["Lending by the IMF", www.imf.org, April 2019]

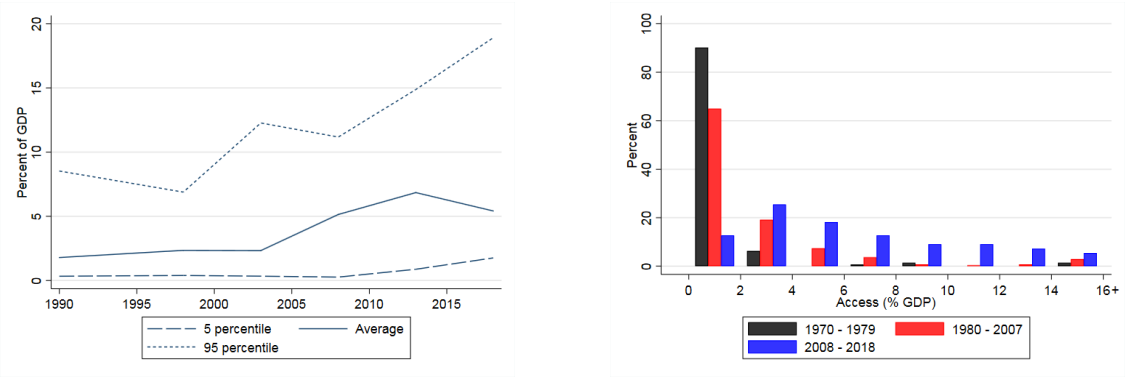
Conceptually, catalytic finance will thus work if the IMF's decision to lend is *strategic complements* with the adjustment effort of the program country and the roll-over decision of private sector creditors (Morris and Shin (2006)). However, the empirical literature on whether IMF programs have indeed positive catalytic effects for a wide range of capital flows is mixed. This paper shows that a possible explanation for the rather inconclusive empirical evidence to date is the neglect of the size of an IMF program. Applying a novel identification strategy to account for endogenous selection into (large) adjustment programs and using a comprehensive panel data for a maximum of 103 countries over the 1990-2018 period, we show that the catalytic effect of IMF financial assistance is weakened - and potentially reversed - if the size of a program exceeds a certain level. Our main results are confirmed by a host of robustness exercises. We suggest several mechanisms through which large programs can weaken the catalytic function of IMF lending. First, while IMF-supported economic adjustment and favorable terms of financing reduce the probability of default by strengthening the country's balance of payments position and its future capacity to repay external liabilities, the IMF's de facto preferred creditor status can cause it to crowd out the claims of other creditors by increasing the loss given default of these claims, since they are junior to those of the Fund. Depending on the volume of IMF financial assistance relative to the debtor country's overall funding need, the crowding-out effect may even worsen a country's prospects for a successful return to the markets, thus undermining the catalytic effect of IMF lending. Second, the bargaining power of the IMF when it comes to ensuring appropriate economic adjustment in the course of the program via strong conditionality is substantially weakened if the Fund has itself large claims vis-à-vis the receiving country and expects large repayments falling due in the near- and medium-term.[1] As a result, private investors might lose confidence in the IMF's ability to ensure that the program country adopts sound policies and strengthens its repayment capacity.[2] A third reason why excessive volumes of IMF lending might weaken their catalytic effect is that large - and relatively upfront - financing packages from the

[1] As John M. Keynes (as quoted in *The Economist* (13 February 1982), p. 11) has put it, "[if] you owe your bank a hundred pounds, you have a problem. But if you owe a million, it has."

[2] In a similar vein, Saravia (2013) shows that if a Fund intervention is not perceived as improving a difficult situation, or if its role as monitor is perceived as ineffective, the IMF's presence can lead to a reduction of a country's borrowing maturity.

IMF in the presence of fiscal solvency concerns offer a welcome opportunity (via the enhancement of liquidity) for private creditors to exit, which also leads to a replacement with official debt that is much harder to restructure. Against this background, a catalytic effect is more likely to be observed for smaller programs where the IMF's share in the needed external financing volume is rather limited (Deutsche Bundesbank (2012)). We consider it vital to better understand the effects of large volumes of IMF lending not only because the average size of IMF arrangements has increased and larger arrangements have been agreed more frequently over time (see Figure 1), but also because the IMF's effectiveness in helping countries to overcome balance-of-payments problems has recently been questioned in policy circles.

Figure 1: Distribution of IMF arrangement sizes



(a) (b)

Sources and notes: Average size of IMF arrangements (a) and the distribution of IMF arrangement sizes (b). Program size is measured in percentage of recipient countries' GDP. Data on IMF arrangements (including their respective size) is taken from the IMF website and program documents. The nominal GDP data is taken from the World Bank's World Development Indicators (WDI).

In this paper, we begin our analysis by presenting a simple theroretical framework of catalytic finance and propose an extension which would account for the preferred-creditor status of the IMF. In our empirical analysis, we follow the approach by Lang (2016) and Gehring and Lang (2018) to address the problem of endogenous selection into IMF programs, making use of an instrumental variable (IV) that combines temporal variation in the IMF's liquidity with cross-sectional variation in a country's prior probability of participating in an IMF program. In order to circumvent possible endogeneity concerns regarding our measure of program size, we propose a new IV that has not yet been used in the literature, namely the countries' individual access limits to IMF ressources - a measure that varies primarily because of institutional rules. We follow the approach by Díaz-Cassou, García-Herrero, and Molina (2006) and Erce and Riera-Crichton (2015) and study the IMF's catalytic role through the lenses of gross capital flows as reflected on the financial account. Consistent with our concept of catalytic finance in the context of a country's external financing need, we focus on gross inflows of foreign investors and its different components.[3] We contribute to the literature not only by providing new evidence

[3]As shown by Forbes and Warnock (2012) and Broner, Didier, Erce, and Schmukler (2013), resident and foreign investors' reaction functions are quite distinct. Moreover, these papers demonstrate that gross capital flows are very large and volatile, especially relative to net capital flows. They also look at the sources of fluctuations driving capital flows and provide evidence that crises can affect domestic and foreign agents asymmetrically.

for the existence of a generally positive catalytic effect of IMF lending, but also add to the debate the important and multi-faceted role of program size. At the same time, we offer a new IV for the latter and largely confirm some previous results from the relevant empirical literature, while also showing the relevance of program size for their results.

The rest of this paper is structured as follows. In Section II, we survey some existing theoretical hypotheses regarding the catalytic effect of IMF lending and give a brief overview of the relevant empirical literature. In Section III, we present our theoretical framework. Section IV describes the data, presents the empirical strategy, and reports our main results. Section V concludes.

2 Existing Literature

A number of *theoretical* contributions support the positive view that IMF financing can act as an important lever, or catalyst, for attracting other funds. Corsetti, Guimaraes, and Roubini (2006) and Morris and Shin (2006) analyze the conditions under which the catalytic role exists using a global games framework. They argue that IMF lending is indeed able to reduce the incidence of panic-driven liquidity crises. Similarly, Peñalver (2004) shows that subsidized lending by the Fund below the prevailing market interest rate induces the borrowing country to exert adjustment effort to avoid default. By preventing default and raising future rates of return on investment, official lending encourages larger private capital flows. In a framework of panic-driven liquidity runs, Zwart (2007) uses a bank run model to show that catalysis may not materialize given that, through its signaling effect, IMF support can trigger capital flight. In terms of the optimal size of an IMF program both Corsetti et al. (2006) and Zwart (2007) argue that larger IMF resources strengthen the catalytic effect. While Corsetti et al. (2006) claim that higher IMF lending leads to a lower ex-ante probability of a crisis by providing a stronger coordination effect, Zwart (2007) contends that a larger loan signals that the IMF is confident that its involvement will be effective amplifying the positive signalling effect which serves to coordinate investors.[4] However, none of these studies explicitly accounts for the private creditors' higher loss given default resulting from the preferred creditor status of the IMF as well as the Fund's weakened bargaining power when it comes to enforcing necessary economic adjustment (see also Section 1).

An extensive literature that has studied *empirically* the significance of the IMF's catalytic effect has at best delivered mixed evidence (for a discussion of earlier contributions see Giannini and Cottarelli (2002)). Most of the literature has focused on the financial account and specific categories of net capital flows. A number of these studies find no evidence of catalytic effects (Rodrik, 1995, Bird and Rowlands (2002), or Bird and Rowlands (2008)). Some authors such as Jensen (2004), and Edwards (2006) even find a negative effect. A caveat associated with focussing on net flows is, however, that the required adjustment in the current account balance, which is a key objective of most IMF programs, by definition implies lower net capital inflows (at least for countries with flexible exchange rates). Some studies therefore focus on gross inflows or use bond spreads (Saravia and

[4] Zettelmeyer (2000) and Jeanne and Wyplosz (2003) even suggest that any IMF intervention that leaves open the possibility of multiple equilibria would induce private sector creditors to act so as to undermine the program. They argue that IMF bailouts can work only when there are enough resources to fill financing gaps of any possible size.

Mody (2003)) or the maturity structure of public debt (Arabaci and Ecer (2014)) as a proxy to gauge investors' willingness to lend to program countries. Saravia and Mody (2003) conclude that there is a positive catalytic effect of IMF-supported programs when they are viewed as likely to lead to policy reform and when economic fundamentals have not deteriorated too much. Van der Veer and de Jong (2010) investigate the catalytic effect for gross inflows and find that the IMF is effective in mobilizing private capital flows for countries that do not restructure their debt. Díaz-Cassou et al. (2006) focus on different types of gross capital inflows and show that the catalytic effect differs very much depending on the type of capital flow and the program's objective (e.g., precautionary vs. non-precautionary). In a similar vein, Erce and Riera-Crichton (2015) study the Fund's catalytic role in the context of gross capital flows and find significant differences in how resident and foreign investors react to IMF programs as well as in inward and outward flows. They assert that IMF lending does not catalyze foreign capital but affect the behavior of resident investors, who are both less likely to place their savings abroad and more likely to repatriate their foreign assets. As we will argue later, however, issues with accounting for the inherent selection bias results in a substantial downward bias of any estimates of the catalytic effect and is likely to be behind the inconsistencies in the empirical literature. In a recent contribution, Gehring and Lang (2018) provide a novel tool to investigate the causal effects of IMF lending and present evidence for a positive catalytic effect. They show that the IMF can cushion against falling creditworthiness, despite contractionary adjustments related to its programs.

Only a few studies have also investigated the role of *program size*. Saravia and Mody (2003) show that larger programs increase the probability of both bond issuance and lower spreads. Analyzing individual loan transactions and new bond issues, Mody, Eichengreen, and Kletzer (2005) find, however, that larger IMF financial assistance is associated with slightly higher spreads in the market for bank loans. Killick (1995) focuses on IMF programs in developing countries and argues that larger lending may be fuelling future capital outflows because of moral hazard. Benelli (2003) compares actual net private capital flows with projected values and finds a negative correlation between successful IMF programs (i.e., if the initial program projections for net private capital flows are met or exceeded) and the size of IMF lending. He argues that this finding is likely to be explained by a tendency of IMF staff to generate relatively optimistic projections about private capital inflows in order to deal with binding lending constraints. Díaz-Cassou et al. (2006) also test whether larger IMF financial packages attract more capital inflows. According to their results, an increase in the size of the programs leads to higher FDI flows while it discourages cross-border bank lending. Differentiating between facilities, the authors show that arrangements under the Extended Fund Facility (EFF) seem to have a positive catalytic effect when large enough, namely above access limits. These studies (in particular those that focus directly on capital flows) usually measure the size of the IMF loan only as a percentage of a country's quota within the IMF. It is not clear, however, whether such a measure appropriately captures the aforementioned possible crowding-out effect owing to senior offical lending as countries' quota shares at the Fund are in practice only infrequently adjusted and subject to complex political considerations. A more appropriate procedure would thus be to normalize the amount of IMF lending by the country's nominal GDP. Moreover, none of these studies has addressed possible endogeneity concerns regarding any measure of program size. A notable exception is

Chapman, Fang, Li, and Stone (2017) who apply an IV-approach to estimate the effect of program size on sovereign bond yields. The authors find that larger crisis loans are associated with lower interest rates. However, there are in our view concerns regarding the validity of their instruments (see also Section 4.2). In addition, they measure IMF credit directly in millions of SDRs which implicitly attaches substantial weight to larger countries in the sample.

We contribute to this strand of literature by investigating the role of program size in detail and by proposing a novel IV that can be used to address potential endogeneity issues in this regard. At the same time, we provide new evidence for a generally positive catalytic effect of IMF lending using a new and comprehensive dataset which covers almost all IMF programs in the General Resource Account (GRA) over the last thirty years and which exploits the fact that at the height of the global financial crisis a substantial number of (large) programs were approved. Moreover, we highlight the need to incorporate possible crowding-out effects of an official senior lender into theoretical models of IMF catalysis.

3 Theoretical Framework

This section presents the theoretical framework of our analysis. We basically start by outlining a particular version of an existing model developed by Corsetti et al. (2006) which assumes seniority of IMF loans and predicts a positive relationship between the catalytic effect of IMF lending and the size of an IMF loan. We then proceed by proposing a possible extension of the model which accounts for a higher loss given default in case the IMF has decided to provide liquidity. As we will show, this could lead to a threshold above which larger IMF loans could start to weigh on the catalytic effect and potentially reverse it.

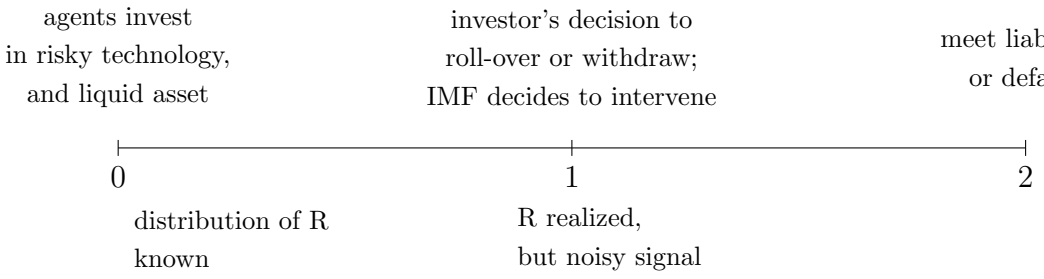
Let us start by considering a small open economy with a three-period horizon. The economy is populated by a continuum of agents of mass 1 where each agent is endowed with E units of resources and borrows D from a continuum of international investors also of mass 1. The investors are only willing to lend to the country on a short term basis (i.e., only for one period). The IMF, as an international lender, may provide the country with liqudity in the interim period. The institution is assumed to be a large player in the world economy and has access to loanable resources up to L (which is common knowledge). The actual disbursement of IMF loans is uncertain and the IMF takes the decisions to disburse L conditional on its information (i.e., its private signal) about the state of the economy. The international interest rate r^* at which all international lending and borrowing by domestic agents takes place is normalized to zero. Domestic agents invest in risky domestic projects which yield a stochastic rate of return R in period 2. If projects are instead discontinued and liquidated early in the interim period (i.e., period 1), they yield a return of $R/(1+\kappa)$. While the expected return from these projects in period 2 is well above r^* (i.e., $E_0 R > 1 + r^*$), the investment is illiquid and a discontinuation of these projects in the interim period leads to a cost of $\kappa > 0$ per unit of investment.

Figure 2 summarizes the sequence of decisions. *In period 0*, agents in the economy invest their available resources (i.e., their own endowment E and borrowed resources D) in the domestic risky technology I and an international liquid asset M. The potential size of IMF loans L are known to the agents. L, D, E, I and M are all given parameters.

In the interim period, international investors decide whether to roll over their loans D or withdraw. *Simultaneously*, the IMF decides whether to intervene and provide liquidity in the amount of L. The (short-term) liquidity that the country needs in the interim period is measured as xD, where we denote with x the fraction of international investors who refuse to roll over (cf. Corsetti et al. (2006), p. 446). Domestic agents have different means to meet these obligations. They can either use their stock of liquid resources, the financial assistance provided by the IMF, or they can liquidate some fraction z of the long-term investment project I, getting $zRI/(1+\kappa)$. The country will thus have to incur liquidation costs when $xD > M+L$ (i.e., z will be such that $xD-(M+L) = zRI/(1+\kappa)$). The country will default in the interim period when domestic agents are unable to meet their short-term obligations despite complete liquidation of long-term projects (i.e., when $xD > M + L + RI/(1+\kappa)$).

In the last period, the country pays back its liabilities consisting of private debt $(1-x)D$ plus any outstanding IMF loan L, using the total resources left consisting of $R(1-z)I$ plus any liquidity left over from the interim period (i.e., $\max\{M+L-xD, 0\}$). If the liabilities exceed available resources, the country defaults in period 2. For that scenario, we choose the most realistic case and assume that loans by the IMF have seniority relative to private loans (see Appendix in Corsetti et al. (2006)). Even though there is no legal basis for the IMF's preferred creditor status (Martha (1990)), it has been an agreed principle among the international community (see, for instance, Schadler (2014)).[5]

Figure 2: Timeline of events



The *payoffs* of international investors and the IMF depend on the decisions which they are taking. When the country does not default in the final period, the 'optimal decision' for investors would be to roll over their loans in period 1. In this case, we again follow Corsetti et al. (2006) and assume that this yields a benefit that is higher relative to withdrawing with a payoff equal to a positive constant b. Instead, when investors do not withdraw in the interim period and the country ends up defaulting they pay a cost equal to $-c$. The objective function of the IMF follows a similar logic and is intended to capture the idea that the IMF wants to limit the inefficiency costs that are associated with early liquidation but can only lend to a country with relatively sound fundamentals. As for private international investors, providing liquidity in the interim period when the country does not default is optimal and yields a benefit equal to B. If the country

[5] Cordella and Powell (2019) provide an explanation for the fact that countries almost always repay loans from the IMF before others, even though preferred treatment rarely appears in legal contracts. They develop a model which shows that the preferred creditor status can actually arise as an endogenous outcome of the relation of a country with its creditors rather than something that is imposed.

defaults, however, the IMF would face a loss. Relative to not disbursing L, the benefit from providing liquidity is negative and equal to $-C$. These constant parameters (i.e., b, c, B, and C) are used later to construct the payoff function of the private investor and the IMF, respectively.

The fundamental of the economy is characterized by the return of the risky domestic project R which follows a stochastic process and is assumed to be normally distributed with mean μ and variance $1/\rho$. As highlighted in Figure 2, the *information set* of all agents is such that in period 0, the distribution of R is common knowledge in the economy while in the interim period R is realized. At the same time, neither international investors nor the IMF know the true R but each of them receives a private noisy signal. The signal that each private investor i receives is such that

$$\tilde{s}_i = R + \epsilon_i \tag{1}$$

where the individual noise is normally distributed with precision α. We denote its cumulative distribution function by $G(\cdot)$. In the same vein, the IMF receives a noisy signal $\tilde{S}$ such that

$$\tilde{S} = R + \eta \tag{2}$$

where η is also assumed to be normally distributed with precision β and its cumulative distribution function is denoted by $H(\cdot)$. Again, we follow Corsetti et al. (2006) and proceed by assuming a very uninformative public signal ($\rho \to 0$) as well as α and β finite such that we can leave aside public information. In the limiting case, the posteriors of both international investors and the IMF are then equal to their respective signals.

We now turn to the issues of *solvency and liquidity*. Without the possibility of international investors to withdraw funds in the interim period, x would be equal to zero. In this case, the country is solvent whenever the gross return from investment is at least equal to its debt net of its international liquidity M, i.e.,

$$RI \geqslant D - M. \tag{3}$$

Thus, in such a case the minimum rate of return neccessary to ensure solvency of the country (the break-even rate) is

$$R_s = \frac{D - M}{I}. \tag{4}$$

In the presence of liquidity runs, the break-even rate may not anymore be sufficient to avoid a default of the country. Supposing that the IMF has not lend to the country in period 1, the country will be solvent in period 2 if and only if

$$R(1-z)I = RI - (1+\kappa)[xD - M]_+ \geqslant (1-x)D - [M - xD]_+. \tag{5}$$

where $[xD - M]_+ = max\{xD - M, 0\}$. Using equations (4) and (5), the minimum rate of return (denoted by $\bar{R}$) at which the country is solvent conditional on no IMF intervention can be written as

$$\bar{R} = R_s + \kappa \frac{[xD - M]_+}{I} \geqslant R_s. \tag{6}$$

Allowing for the possibility of liquidity runs leads to the fact that the break-even rate must potentially increase above R_s whenever there is an early liquidation (i.e., when $xD - M > 0$). This is due to ex post efficiency costs as a result of the international investors' failure to roll over their claims in the interim period.

However, if the IMF intervened in the first period, ex post efficiency costs would be contained and the country will be solvent if

$$R(1-z)I = RI - (1+\kappa)[xD - M - L]_+ \geqslant (1-x)D + L - [M + L - xD]_+. \tag{7}$$

In this case, the relevant threshold for default $\bar{R}_L$ is given by

$$\bar{R}_L = R_s + \kappa \frac{[xD - M - L]_+}{I} \geqslant R_s. \tag{8}$$

As shown by Corsetti et al. (2006), $\bar{R}$ and $\bar{R}_L$ partition the set of the fundamental R into three regions: no crisis occurs when $R > \bar{R}$; there is a crisis when $R < \bar{R}_L$; for R in between, a crisis only occurs if the IMF decides not to intervene. Regarding the latter, note that given our assumption of seniority of IMF loans, the Fund keeps lending up to the point in which the country has just enough resources to pay back L. The solvency threshold for the return on the risky investment that is relevant for the IMF's decision to lend (i.e., $\bar{R}_{IMF}$) is thus given by

$$R(1-z)I = RI - (1+\kappa)[xD - M - L]_+ \geqslant L \tag{9}$$

which provided that $[xD - M - L] > 0$ can be written as

$$\bar{R}_{IMF} = (1+\kappa)\frac{[xD - M]}{I} - \kappa\frac{L}{I} \tag{10}$$

$$= R_s \left[(1+\kappa)\frac{[xD - M]}{D - M} - \kappa\frac{L}{D - M}\right]. \tag{11}$$

Given that the preferred creditor status of the IMF reduces the likelihood for the Fund to not recover its loans fully, it is not surprising that one can show that $\bar{R}_{IMF} < \bar{R}_L$ (see Corsetti et al. (2006), p. 468). The catalytic effect of the IMF can actually materialize in two ways. First, it directly reduces the amount of investments that need to be liquidated by providing liquidity in the interim period. Second, it indirectly lowers liquidation costs from runs by reducing the international investor's willingness to withdraw for any given realization of R.

The next step is the characterization of the *equilibrium* in this three-period economy. Again, we closely follow the steps of Corsetti et al. (2006). The core of their model is the coordination problem and the strategic uncertainty faced by international investors. All investors are uncertain about the information of all other investors and the IMF. We assume that in the interim period, the investors and the IMF take their decisions independently and simultaneously.[6] The strategic uncertainty is reflected in the fact that

[6]Investors are well aware of the fact that the contingent amount of liquidity L intitally committed by the IMF may not be available ex post and correctly form their expectations about the likelihood of IMF intervention. The IMF will refuse to lend if, based on its signal, there is no prospect of being repaid in full.

the expected payoff of each investor from rolling over a loan in period 1 depends positively on the IMF's willingness to provide liquidity as well as on the fraction of all other investors that decide to not withdraw their loans in the interim period. In the same vein, the IMF's expected payoff depends positively on the fraction of international investors that decide to roll over their loans. Corsetti et al. (2006) show that there is a unique equilibirum where all agents employ trigger strategies such that an international investor only decides to roll over its loan if the private signal on the return of the risky investment is above some critical value $\tilde{s}^*$, which is identical for all international investors. Likewise, the IMF intervenes and provides liquidity only if its own private signal is above some critical value $\tilde{S}^*$.

The equilibirum is characterized by *five critical thresholds*. There are three thresholds which are critical values for the fundamental R, below which the country defaults. For returns on investment lower than $\bar{R}$, the country defaults conditional on no IMF intervention. For all values of R below $\bar{R}_L$, the country always defaults, independent of an IMF intervention. However, if R is below $\bar{R}_L$ but still above $\bar{R}_{IMF}$, the country only defaults on private international investors. If the fundamental is even below $\bar{R}_{IMF}$, the country always defaults on both the IMF and private investors. Hence, the relevant thresholds for private investors are $\bar{R}$ and $\bar{R}_L$, while for the IMF the relevant threshold guiding its decision to intervene is given by $\bar{R}_{IMF}$.[7] The other two thresholds characterizing the equilibrium are those for the private signal that reaches the international investor ($\tilde{s}^*$) and the Fund ($\tilde{S}^*$), respectively.[8]

As shown in Section A.1.1, the equilibrium of that model is completely characterized by five endogenous variables ($\bar{R}$, $\bar{R}_L$, $\bar{R}_{IMF}$, S^*, and s^*) and the following five equations:

$$\bar{R} = R_s \left[1 + \kappa \frac{[G(s^* - \bar{R}) \cdot D - M]}{D - M} \right]. \tag{12}$$

$$\bar{R}_L = R_s \left[1 + \kappa \frac{[G(s^* - \bar{R}_L) \cdot D - M - L]}{D - M} \right]. \tag{13}$$

$$\bar{R}_{IMF} = R_s \left[(1 + \kappa) \frac{[G(s^* - \bar{R}_{IMF}) \cdot D - M]}{D - M} - \kappa \frac{L}{D - M} \right]. \tag{14}$$

$$S^* = \bar{R}_{IMF} - H^{-1} \left(\frac{B}{B + C} \right). \tag{15}$$

$$\frac{b}{b + c} = G(\bar{R}_L - s^*) + \int_{\bar{R}_L}^{\bar{R}} g(R - s) \cdot H(S^* - R) dR \tag{16}$$

The last equation is derived from the payoff function of the private investor ($\mathscr{W}_{PI}$) and the zero-profit condition (see also Section A.1.1). The former is denoted as

[7] Note that it can be shown that $\bar{R}_{IMF} < \bar{R}_L < \bar{R}$ (see Corsetti et al. (2006)).

[8] As mentioned earlier, we assume an arbitrarily more uninformative public signal such that the posteriors will coincide with the private signals. We therefore also follow Corsetti et al. (2006) and express all signals and thresholds in terms of the agent's posterior denoted without tilde (i.e., S, s^*, and S^*).

$$\mathscr{W}_{PI} = b\left[1 - \left(G(\bar{R}_L - s) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^* - R)dR\right)\right] - c\left(G(\bar{R}_L - s) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^* - R)dR\right), \tag{17}$$

where $g(\cdot)$ is the probability density function and the constants b and c capture the respective benefits and costs of lending to the country. $G(\bar{R}_L - s)$ is the probability that the investor assigns to a default regardless of the IMF's decision to intervene or not as the country will default on private loans for any R such that $R \leqslant \bar{R}_L$. For any R comprised between $\bar{R}_L$ and $\bar{R}$, the country will only default if the IMF fails to intervene. This conditional probability is denoted by $H(S^* - R)$.

The equations characterizing the equilibrium can be used to show that according to the model the catalytic function of IMF lending is strenghtened when the Fund provides more liqudity L, i.e.,

$$\frac{ds^*}{dL} = -\frac{\frac{\zeta_2\zeta_5}{g(\bar{R}_L - s^*)} + \frac{\zeta_3\zeta_6\kappa}{g(\bar{R}_{IMF} - s^*)(1+\kappa)}}{[\zeta_4(1-\zeta_1) + \zeta_5(1-\zeta_2) + \zeta_6(1-\zeta_3)]} < 0. \tag{18}$$

where $\zeta_1, \zeta_2, \zeta_3 \in (0,1)$ and $\zeta_4, \zeta_4, \zeta_6 > 0$ (see Section A.1.2 for a derivation of this expression). In other words, the optimal threshold for private investors s^* declines when L increases such that private investors are willing to roll over their loans for weaker private signals about the country's fundamental. The reason for that is twofold. First, IMF liquidity directly lowers the costly liquidation of investment projects in the interim period. Second, IMF loans also (indirectly) affect the coordination problem faced by international investors in a sense that they lower the threshold at which private investors refuse to roll over their debt. This effect is strengthened the more liquidity the IMF provides.

After having outlined the prediction of the existing model by Corsetti et al. (2006) of the effect of program size on the Fund's catalytic role, we now turn to a *possible extension of the model*. Our proposed extension aims at directly accounting for the fact that owing to IMF seniority, the international private investors' return on their investment is lower conditional on a crisis. All else equal, this should intuitively reduce the investors' willingness to rollover their loans for any given private signal (i.e., it should raise s^*).[9] One way of incorporating this effect into the model would thus be to modify the payoff function of private investors and include a term that captures the idea that the penalty for lending to a defaulting country (conditional on IMF intervention) increases with the volume of IMF liquidity. The IMF itself assigns a probability $H(\bar{R}_{IMF} - S)$ to the failure of the country despite its intervention (see equation (29), Section A.1.1). When such a scenario materializes, the costs for private investors should be higher and increase with the amount L for reasons discussed in Section 1. Hence, we could modify the payoff function of private investors such that

[9] Corsetti et al. (2006) also mention that such an effect would move the threshold in the opposite direction relative to what is predicted by equation (20).

$$\mathscr{W}_{PI} = b\left[1 - \left(G(\bar{R}_L - s) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^* - R)dR\right)\right] - c\left(G(\bar{R}_L - s) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^* - R)dR + H(\bar{R}_{IMF} - S^*)\lambda L^{\alpha}\right). \quad (19)$$

where λL^{α} would capture the additional costs of default which directly depend on the amount disbursed by the IMF. Note that in the limiting case of $\lambda \to 0$, the extended version of the model collapses to the original model (cf. equation (17)) which would corespond to the presumption that the additional costs of default for private investors owing to the preferred creditor status of the IMF would be negligibly small.

Using our expression for S^* (i.e., equation (15)) as well as the zero-profit condition we, get the (new) equilibrium condition

$$\left(\frac{b}{b+c}\right)\left(\frac{B}{B+C}\right)\lambda L^{\alpha} = G(\bar{R}_L - s^*) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^* - R)dR \quad (20)$$

Replacing (16) with (20) and applying the same steps as in Section A.1.2, it can be shown that this could lead to a threshold after which higher volumes of IMF lending start to reduce the private investors' willingness to roll over their debt and thus weaken the IMF's catalytic function:

$$\frac{ds^*}{dL} = \underbrace{-\frac{\frac{\zeta_2\zeta_5}{g(\bar{R}_L - s^*)} + \frac{\zeta_3\zeta_6\kappa}{g(\bar{R}_{IMF} - s^*)(1+\kappa)}}{[\zeta_4(1-\zeta_1) + \zeta_5(1-\zeta_2) + \zeta_6(1-\zeta_3)]}}_{\text{"coordination effect"}} + \underbrace{\left(\frac{b}{b+c}\right)\left(\frac{B}{B+C}\right)\lambda\alpha L^{\alpha-1}}_{\text{"crowding-out effect"}} \lessgtr 0. \quad (21)$$

The first term remains unchanged as compared to the original model and still captures the positive coordination effect of higher L. The second term instead is new and results from the additional costs of higher IMF lending in the event of default (see also Section 1). If the additional penalty owing to the Fund's involvement is rising strongly in L (i.e., if $\alpha > 1$), the second effect - denoted as 'crowding-out effect' - could eventually dominate the positive coordination effect. Hence, ever larger IMF lending could ultimately weaken - or even reverse - the positive catalytic effect.

Still, it should be noted that the proposed extension of the model by Corsetti et al. (2006) is rather ad-hoc and does not explicitly model all our proposed channels through which excessive volumes of IMF lending might weaken their catalytic effect. In fact, the crowding-out effect does not directly depend on relative shares of liquidity provided by private investors and the IMF, respectively, but is only proxied by the indirect effect through otherwise constant parameters that measure the benefits (b) and costs (c) of lending to the country. An important direction for future research would thus consist of explicitly modeling the possible channels through which large programs can weaken the catalytic function of IMF lending within a rigorous - more microfounded - framework. Nevertheless, our small modification of the model provides a first step in addressing this issue in a formal setup. In the next section, we provide empirical evidence that lends support to an extension of the model in such a direction.

4 Empirical Analysis

This section briefly describes the data, presents the empirical identification strategy, and reports the results. Section A.2 describes the data sources and variable definitions in greater detail.

4.1 Data sources and variables used

The data on our *dependent variable* - gross capital inflows (CIF) and their subcomponents - is drawn from the analytic presentation of the IMF's Balance of Payments Statistics Yearbooks (BOP). More specifically, we focus on capital inflows by foreigners, which are measured as changes in liabilities of the reporting country's residents held by foreign nationals (see Broner et al. (2013)). As an alternative dependent variable we also use a country's sovereign long-term foreign-currency rating taken from Standard & Poor's as a proxy to measure the creditworthiness of a country (see Gehring and Lang (2018)).

Information on our *treatment variable* (i.e., IMF interventions) is collected from the IMF's website and various IMF program documents. The explanatory variable of interest, 'IMF program', is constructed as an indicator that takes the value of one if country i was under an IMF program in the respective year t.[10] We focus our analysis on the IMF's traditional credit facilities which are funded through its general resources account (GRA): the IMF Stand-By Arrangement (SBA) and the IMF Extended Fund Facility (EFF).[11] While both facilities feature ex-post conditionality, the SBA is intended to address short-term or potential balance of payments problems while the EFF is the Fund's main tool for medium-term support to countries facing protracted balance of payments problems. Hence, an EFF implies a longer program engagement (up to 4 years instead of a maximum of 3 years under the SBA) and a longer repayment period (up to 10 years instead of 5 under the SBA). After this selection, we finish with a sample of over 130 programs. We collect information on the size of the programs, their type (including whether it was treated as a precautionary arrangement), the duration, and the amount which was finally disbursed. As can be seen from Figure 3, there is a large variation both in the size of the programs as well as their geographical distribution.

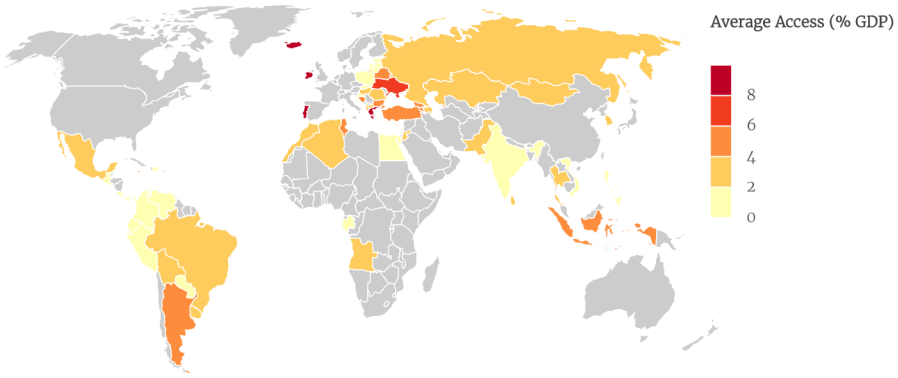
Finally, our dataset includes *additional variables* that are used as controls in the panel regressions, or as instruments when implementing our instrumental variables strategy. Regarding the latter, we collect data on the Forward Commitment Capacity (FCC) from individual IMF Annual Reports. The FCC is the Fund's measure of the resources available for new financial commitments in the general resources account. Moreover, we construct a variable that measures a country's access limit to IMF resources under normal access as a percentage of nominal GDP. It thus combines information on general limits under normal access with the size of countries' IMF quota. Both of these variables vary over

[10] Our results are robust to alternative specifications such as assigning the value of one only if country i was under an IMF program for at least five months in year t (as in Dreher and Sturm (2012) and Gehring and Lang (2018)).

[11] The IMF's concessional financial support through the Poverty Reduction and Growth Trust (PRGT) is geared toward low-income countries and serves a slightly different objective than programs financed through the GRA. PRGT-programs are usually intended to help catalyze additional foreign aid. As a robustness check, we later include PRGT-programs as well as blended arrangements for countries in our sample.

time as they are subject to regular reviews. As further controls we include lagged values of standard variables usually used in regressions explaining capital flows (i.e., 'pull-factors') such as real GDP growth, the investment rate, a measure of exchange rate volatility, the interest rate differential with the U.S., and the Chinn-Ito Index of financial account liberalization. Except for the latter, the variables are taken from the IMF's International Financial Statistics (IFS), and the World Bank's World Development Indicators (WDI). The Chinn-Ito Index (Chinn and Ito (2006)) is taken from their website. In addition, we include the political risk index from the International Country Risk Guide (ICRG) surveys as a proxy for institutional quality as well as crisis variables from Laeven and Valencia (2018) that indicate whether a country is in a banking, currency, or sovereign debt crisis. Note that 'push-factors' traditionally considered such as the U.S. short-term interest rate, expected U.S. real GDP growth or a measure of global risk aversion are all captured by our time-fixed effects.

Figure 3: Geographical distribution of IMF arrangement sizes



Sources and notes: Average size of IMF arrangements by country. Program size is measured in percentage of countries' GDP. Data on IMF arrangements and their respective size is taken from the IMF website and program documents. The nominal GDP data is taken from the World Bank's World Development Indicators (WDI). The map was constructed using the online tool 'map in seconds' created by Eugene Chen at Darkhouse Analytics (http://mapinseconds.com/).

The database we compile covers 103 countries over the 1990-2018 sample period. We concentrate on high-income and middle-income countries and exclude countries that are either very small or very poor (i.e., low-income countries). As also argued by Broner et al. (2013), small countries are a concern because they might display an artificially high volume of financial transactions due to their role as offshore financial centers or tax havens. Low-income countries instead are usually eligible for IMF concessional financing through the Poverty Reduction and Growth Trust (PRGT). These programs mostly catalyze other official financing (e.g., foreign aid from multilateral development banks) which is not the focus of this paper. Table A1 reports the descriptive statistics for the variables used in this study.

4.2 Identification strategy

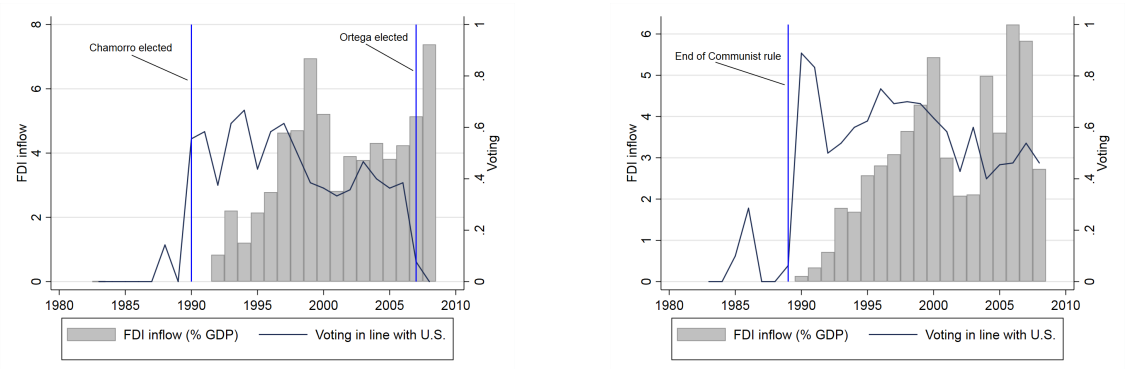
An important difficulty that arises when assessing the impact of IMF lending is the potential selection bias due to the fact that borrowing countries generally enter an IMF program when they are facing a difficult economic situation. Thus, analyses that do not appropriately account for this nonrandom selection of countries tend to underestimate the catalytic effect of IMF programs.[12] Many studies in this literature apply standard panel regressions or matching procedures to address endogeneity concerns and compare program and nonprogram countries that are as similar as possible in terms of observable characteristics. However, as argued by Gehring and Lang (2018) and also shown later in this section, this is unlikely to remove the entire bias and, in addition, often creates a bad control problem. Most of the more recent studies apply an instrumental variable approach and follow the strategy proposed by Barro and Lee (2005) (see, amongst others, Eichengreen, Gupta, and Mody (2008), Van der Veer and de Jong (2010), Jorra (2012), Erce and Riera-Crichton (2015), or Balima and Sy (2019)). They argue that the decision by the IMF to approve a Fund-supported program is strongly influenced by the Fund's major shareholders, in particular the United States. As such, program participation is determined by the country's economic situation and its political (or economic) proximity to the U.S.. One of the most frequently used instruments for IMF programs is a measure that captures the link between a country and the U.S., namely the borrower's ties with the Fund's major shareholders at the United Nations General Assembly (see also Dreher and Sturm (2012)). However, the underlying assumption that IMF programs are the only plausible channel that links a country's political proximity to the U.S. and the outcome variables is unlikely to hold. As Gehring and Lang (2018) put it, "[a] country's economic condition is plausibly related to the political preferences of the country's government via more direct channels." A government which fosters close relationships with western countries is very likely to have an inclination for more liberal, market-based economic policies. These in turn have a direct impact on capital flows of any kind, violating the necessary exogeneity assmption and causing a potential bias in respective IV estimates. Figure 4 shows two country cases (exemplary for many post-communist and Latin American countries) which illustrate this fact. After a change in government, both countries - Nicaragua and Poland - underwent a drastic transition from an economy based on state ownership and central planning, to a capitalist market economy. As can be seen, this was accompanied by a spike in UN voting alignment with the U.S. and followed by a surge in capital inflows over the subsequent decades. In both cases the government was elected on the promise of far-reaching reform plans: the 'plan Mayorga' of the Chamorro administration and the 'Balcerowicz plan' of the Polish Prime Minister Mazowiecki. While both countries had some IMF-supported arrangement during that time, it is very likely that both governments would have implemented similar free-market liberal reforms by itself, even in complete absence of IMF influence.[13] These market-friendly reform plans are in turn likely to have caused a surge in foreign investment inflows. Interestingly, the re-election

[12] As shown by Bird and Rowlands (2008), results concerning catalysis may indeed be sensitive to the method chosen for dealing with selection bias.

[13] "Plan Mayorga, as outlined during the electoral campaign and in the early months of the new administration, called for [...] bring[ing] inflation to zero within 100 days through drastic austerity, [and] a new 'strong currency' [...] followed by structural adjustment and privatization [...]" (see Prevost and Vanden (1997), p. 84)

of Daniel Ortega as Nicaragua's president has led to substantially weakend political ties with the U.S. which is reflected in the drop of UN voting alignment. The accompanying spike in FDI inflows was mainly caused by the re-established strong political ties with Venezuela which significantly increased its official financing.

Figure 4: UN voting alignment with the U.S. and FDI



(a) Nicaragua (b) Poland

Sources and notes: The solid line is the time series of the share of countries' key votes at the UN which were in line with the U.S.. The data is taken from Dreher and Sturm (2012). The grey bars are foreign direct investment (FDI) inflows in percent of GDP taken from the IMF's Balance of Payments Statistics Yearbooks.

In our empirical analysis we take a different approach and follow Lang (2016) and Gehring and Lang (2018) who make use of an instrumental variable that combines temporal variation in the IMF's liquidity with cross-sectional variation in a country's prior probability of participating in an IMF program. Based on Lang (2016), we thus define the IV as

$$IV_{i,t} = IMFprobability_{i,t} \times ln(IMFliquidity_t) \tag{22}$$

$IMFprobability$ is a country's probability of having participated in an IMF program in the past, defined as the fraction of years country i has been under an IMF program between 1970 and year t.[14] In our case, $IMFliquidity$ denotes the IMF's time-varying Forward Commitment Capacity (FCC), defined as uncommitted usable resources plus repurchases one-year forward less repayments of borrowing due one-year forward and less the prudential balance. This concept was introduced in 2002 and is the Fund's most direct measure of the amount of liquid resources available for new loan commitments.[15]

[14]Similar to Gehring and Lang (2018), we start the count of years of past IMF participation two decades before our actual observation period starts. This prevens this variable from fluctuating especially for the early years of the sample. At the same time, such an approach increases the plausibility of the exclusion restriction further because the value is determined by earlier periods.

[15]Lang (2016) and Gehring and Lang (2018) use an older concept which was previously used by the Fund to measure available liquid resources, i.e., the liquidity ratio defined as the organization's liquid resources divided by its liquid liabilities. We argue that the FCC is an even more direct measure of IMF liquidity. At the same time, we will later show that we can replicate the qualitative baseline results of Gehring and Lang (2018) which we interpret as evidence that our identification does not depend on the specific use of the FCC. Other studies that apply a similar identification strategy use even more indirect measures of IMF liquidity such as the number of active programs in a given year (Forster, Kentikelenis, Reinsberg, Stubbs, and King (2019)).

The intutition behind this strategy builds on the finding that a country's past participation in an IMF program is a strong predictor of entering a new Fund-supported arrangement in the present (see Bird, Hussain, and Joyce (2004), or Sturm, Berger, and de Haan (2005)). The literature generally explains this finding by pointing to 'recidivism' or political favoritism. Another reason might also be the need for the Fund to roll-over due repayments by means of a new financial arrangement, for instance resulting from an insufficent structural adjustment over the course of previous programs (the so-called 'revolving door' explanation of participation in IMF programs (Conway (2007))). For our identification, we further exploit the fact that the influence of a country's IMF participation history on present program participation differs conditional on the year-specific extent of the IMF's liquidity. More specifically, past program participation is a strong predictor of current program participation in years of relatively low IMF liquidity. When the IMF has instead abundant liquidity (i.e., high liquidity years), a country's IMF participation history becomes a weaker predictor of IMF program participation. A plausible explanation for this pattern that is put forward is "that in high liquidity years, the IMF can be more generous and has an increased incentive to look for additional program countries beyond its more regular clientele" (Gehring and Lang (2018), p. 14). The reason for this might be the finding that international organizations are usually tempted to expand their field of activity and that the incentives to do so might be particularly strong at times of abundant financial resources (Dreher and Lang (2016)).

We run two-stage least squares (2SLS) panel regressions over an unbalanced sample of up to 103 countries over the 1990-2018 period. Our first and second stage is given by

$$IMFprogram_{i,t} = \alpha_1 IV_{i,t} + \alpha_2 IMFprobability_{i,t} + \delta_i + \tau_t + u_{i,t} \tag{23}$$

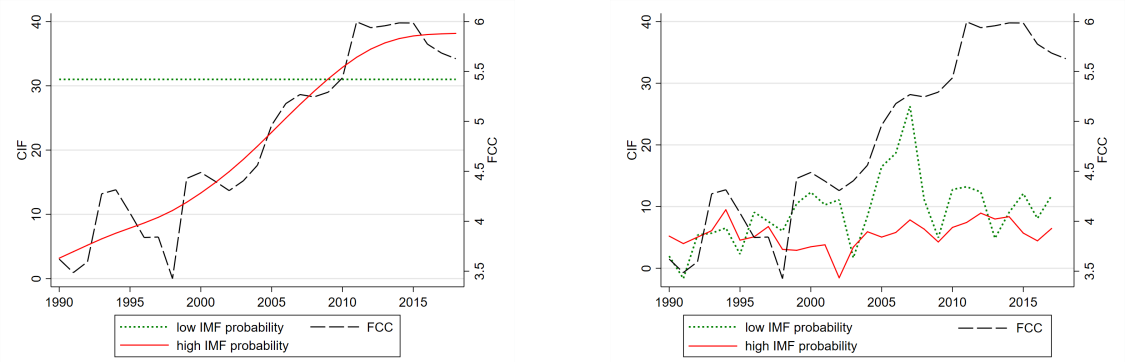
$$CIF_{i,t} = \beta_1 I\widehat{MFprogram}_{i,t} + \beta_2 IMFprobability_{i,t} + \delta_i + \tau_t + \epsilon_{i,t} \tag{24}$$

These regressions control for time- and country-fixed effects as well as for the initial, pre-determined $IMFprobability$ in both stages. Note that the level effect of the year-specific $IMFliquidity$ is absorbed by the time-fixed effect. The key assumption for identifying the causal effect of IMF programs on gross capital inflows is now only the exogeneity of the interacation term conditional on its two constituent terms (see also Gehring and Lang (2018)).

The IV strategy follows the logic of a continuous difference-in-differences setting as in Nunn and Qian (2014) or Temple and Van de Sijpe (2017) and is similar to so-called Bartik (or shift-share) instruments (Goldsmith-Pinkham, Sorkin, and Swift (2018)). As also argued by Gehring and Lang (2018), for the exclusion restriction to be violated, omitted factors would have to be correlated with the year-specific IMF liquidity *and* affect capital flows *differently* in countries with *different* levels of IMF probability. This relationship is, however, very unlikely. The main reason for that is that $IMFliquidity$ varies primarily because of an institutional rule that requires regular reviews of the size and shares of countries' quota at the IMF. The review is usually intended to be completed at least every five years. However, given that these reviews are regularly subject to highly political consideration, they face frequent and sometimes protracted delays. At the same time, the final decision on the overall resource envelope is not exclusively a result of economic considerations. Earlier adjustments were also often proportional to existing

quotas such that changes in the distribution of actual quotas sometimes even lagged behind global economic developments. The timing of IMF liquidity spikes is thus plausibly exogenous to capital flow dynamics in individual countries. Another source of variation in the FCC are large repayments following individual high-access IMF arrangements. However, there are only a very few cases of large loan repayments that significantly affect the IMF's overall liquidity. Furthermore, all these transactions follow a standard and predetermined schedule. It is thus not very plausible to assume that these predetermined repayment schedules resulting from programs with a small number of economically large countries are associated with individual future capital inflow dynamics in other countries (see also Gehring and Lang (2018)).

Figure 5: The IMF's liquidity and trends in capital inflows



(a) Problematic trends (b) Actual trends

Notes: The dashed line is the time series of the IMF's Forward Commitment Capacity (ln). The remaining lines plot mean gross capital inflows in the group of countries that have a low probability of receiving a program (green line, below 85^{th} percentile), and a high probability (red line, avove 85^{th} percentile). Panel (a) shows *fabricated* and potentially problematic trends while panel (b) shows the *actual* trends. Results are similar when using other cutoff percentiles.

In a recent paper Christian and Barrett (2017) show that the strategy of combining cross-sectional and temporal variation can be susceptible to bias arising from spurious trends. In particular, they point out that such a bias can arise if the time series variable exhibits strong nonlinear trends that are strikingly similar to those observed in the outcome variable of interest in the more exposed group of countries but not in the less exposed group. In this case, standard fixed effects controls may not suffice to isolate the exogenous inter-annual variability that is intended to identify the causal effect of interest. To address this concern, we separate countries into a group with a low probability of having a program, and another group with a high probability. Figure 5a shows fabricated trends that would threaten our indentification strategy. The actual trends are displayed in Figure 5b. As can be seen, there seems to be no apparent overlap in long-run trends in any of these groups with the $IMFliquidity$ time series. Moreover, we capture the huge spikes in capital inflows such as the one observed before the global financial crisis by our year-fixed effects and control for a general long-run (linear) trend observed for gross capital flows since the 1990s. At the same time, as we will show later, our main results hold if we use long-term sovereign ratings as a dependent variable, an outcome variable for which the identifying assumption does also not seem to be threatened by spurious trends (Gehring and Lang (2018)).

Having addressed the selection bias associated with program participation in general, we turn to our second variable of interest, namely the size of an IMF program. While most of the selection bias described before should have already been eliminated by our IV strategy for the treatment variable, one might still argue that countries that request exceptionally large amounts of IMF financing find themselves in an especially dire economic situation which could again cause a bias in our estimates of this variable of interest. The vast majority of existing studies who included a measure of program size in their regressions does not account for this possible endogeneity. A notable exception is Chapman et al. (2017) who address these concerns by applying an IV-approach proposing credit outstanding to the Fund as a valid instrument. However, we would argue that - especially for large-access programs - the exogeneity assumption is likely to be violated in this case. Large amounts of credit outstanding increase the potential for future liquidity shortgages as well as the probability of a new IMF program which serves to effectively roll-over the amount falling due to the Fund. This is very likely to directly affect current capital flow dynamics in the countries concerned threatening the exclusion restriction.

In our regression analysis, we therefore use the countries' individual access limits to IMF resources as a percentage of GDP as an instrument to address possible endogeneity concerns regarding our measure of program size. The measure consists of a country's individual IMF quota (in absolute terms) and general access limits that govern the maximum amount of IMF financing that could be requested under normal access. As also shown by IMF (2019), access limits for GRA arrangements can help to explain a large part of the variation in past access decisions. This possibly reflects the importance of the underlying Fund policies and lending frameworks for the actual size of IMF programs. IMF programs which lend amounts above normal limits (so-called "exceptional access" programs) can only be approved on a case-by-case basis under the IMF's Exceptional Access policy, which entails enhanced scrutiny by the Fund's Executive Board. IMF management and staff might thus have been somehow reluctant to propose very large programs. At the same time, in many cases there seems to have been a tendency by the Fund to grant the maximum access possible under normal limits.

Our proposed instrumental variable (i.e., access limits) varies only because of institutional rules. While the process that determines a country's quota at the Fund follows the procedure mentioned before, general access limits are also subject to regular reviews - usually at a 5-year interval - and decided for the membership as a whole. Hence, the sources of variation in access limits are very distant to events in individual country-years and the exclusion restriction is therefore very likely to hold.

4.3 Results

We start by considering the simple correlation between an IMF program and gross capital inflows. As expected given the endogeneous selection into an IMF program, column (1) in Table 1 shows a strong and statistically significant negative correlation. We proceed by progressively adding controls such as country-fixed effects (column (2)), year-fixed effects (column (3)), and a comprehensive set of country-year specific economic and political controls (column (5)) that are traditionally used in regressions explaining capital flow dynamics. Conditioning on all these observable factors plausibly eliminates some part of the negative selection bias and leads to a sizeble drop in the estimated coeffcient which

eventually becomes insignificant.[16] We would thus conclude that IMF programs have a small, yet statistically insignificant, negative catalytic effect. However, as also argued by Gehring and Lang (2018), approaching the selection problem via conditioning on observables is unlikely to be adequate and many of the control variables in this particular setting might in addition suffer from potential bad control problems. More specifically, they might suffer from a particular version of the bad control scenario which involves proxy controls, that is, variables that might partially control for omitted factors but are themselves affected by the treatment (see Angrist and Pischke (2009), pp. 64). It is reasonable to assume that capital flows are a function of many of the same economic and political fundamentals that an IMF program directly affects. As shown by Angrist and Pischke (2009), using a proxy control that is increased (decreased) by the variable of interest generates a downward (upward) bias in the estimated coefficient. We try to mitigate this problem by lagging these variables by one period. Still, this might not entirely solve the issue not least because already the expectation of a future IMF program could have an impact on current fundamentals.[17]

In the next step, we implement the instrumental variable approach (column (6)). We report the first stage in the bottom panel of Table 1. The IV (i.e., the interaction term) is negative and statistically highly significant. As postulated before, the past history of program participation indeed appears to be a less important predictor of current Fund engagement in high-liquidity years. The IV passes the underidentification test. The Kleibergen-Paap (K-P) F-statistic testing for weak identification is about 33 and thus well above the rule of thumb of 10, as well as above the more conservative threshold of 16.38 proposed by Stock and Yogo (2005) for an exactly identified single endogeneous regressor. In a recent paper, Andrews, Stock, and Sun (2019) caution against relying too much on screening F-statistics to detect weak instruments and suggest to make use of weak-instrument-robust inference, that is, tests that remain valid whether or not the instruments are weak. According to the authors, this holds especially for regressions with more than one endogenous regressor, not least because their preferred first-stage F-statistic which corrects for non-homoskedasticity (see Olea and Pflueger (2013)) has not been developed for this case. We therefore also report the p-value of an Anderson-Rubin test (implemented in Stata by Finlay, Magnusson, and Schaffer (2013)), a weak-instrument-robust test of the coefficients on the endogenous regressors. As can be seen, the test rejects the null that the estimated coefficient is equal to zero at the 5%-level.

The second stage of this regression shows that the coefficient of interest now turns positive (with a value of 26.082) and statistically significant. This is expected given the presence of negative selection bias, which was only partly captured by fixed effects and conditioning on observables. Overall, we thus find evidence of a positive catalytic effect of IMF programs which is also economically significant. This holds - and becomes even stronger - if we add our set of controls (see column (7)).

[16] Note that in column (4) we restrain the sample to those countries for which all control variables are available before actually adding them. As can be seen, this does not render the coefficient significant, showing that sample selection depending on the availability of control variables is not a concern.

[17] Moreover, IMF programs typically lasts for some years and the fundamentals usually exhibit some persistence (see also Gehring and Lang (2018)).

Table 1: Baseline w/o Program Size - Aggregate Capital Inflows

Estimation Method	OLS	OLS	OLS	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IMF program	-5.184***	-4.958***	-1.836	-2.391	-0.863	26.082*	33.463**
	(1.809)	(1.806)	(1.949)	(2.346)	(2.269)	(13.779)	(16.877)
Country FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes	Yes
Controls (t-1)	No	No	No	No	Yes	No	Yes
Observations	2,444	2,444	2,444	1,550	1,550	2,444	1,550
First stage results							
IMF liquidity × IMF probability						-0.385***	-0.410***
						(0.067)	(0.087)
IMF probability						2.388***	2.864***
						(0.393)	(0.441)
K-P underidentification LM-statistic						19.214	12.197
K-P underidentification p-value						0.000	0.001
K-P weak identification F-statistic						33.477	22.496
Anderson-Rubin test p-value						0.048	0.028

Sources and notes: robust and clustered standard errors in parentheses. Ordinary least squares and IV regressions. ***Significant at 1%; **significant at 5%; *significant at 10%. The dependent variable is the country's gross capital inflows by foreigners (CIF), measured as changes in liabilities of the reporting country's residents held by foreign nationals. Section A.2 provides further details on sources and variable definitions including all economic and political controls added in columns 5 and 7.

In a next step, we add our measure of program size as a control to the previous regressions. Table 2 shows that the estimated coefficient on program size is negative in all specifications. In particular, once we adequately address the negative selection bias into an IMF program, the effect of program size becomes highly significant. As presumed in Section 1 and Section 3, we thus find evidence that too high volumes of IMF lending can weaken the catalytic effect of a program and could eventually even reverse it. According to our baseline point estimates in column (7), programs with an access level above 8 percent of GDP would no longer have a (positive) catalytic effect.

Table 2: Aggregate Capital Inflows - Controlling for Program Size

Estimation Method	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	IV (6)	IV (7)
IMF program	-1.034	-0.778	3.420	1.471	2.941	28.268**	34.557**
	(1.045)	(1.034)	(2.079)	(1.901)	(2.369)	(14.342)	(16.481)
Access (in % of GDP)	-1.186**	-1.195**	-1.412**	-1.149	-1.120	-3.808**	-4.104**
	(0.564)	(0.568)	(0.641)	(0.880)	(0.881)	(1.640)	(2.079)
Country FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes	Yes
Controls (t-1)	No	No	No	No	Yes	No	Yes
Observations	2,444	2,444	2,444	1,550	1,550	2,444	1,550

Sources and notes: robust and clustered standard errors in parentheses. IV regressions. ***Significant at 1%; **significant at 5%; *significant at 10%. The dependent variable is the country's gross capital inflows by foreigners (CIF), measured as changes in liabilities of the reporting country's residents held by foreign nationals. Access to IMF resources under a Fund-supported program is measured as the total amount approved relative to the country's nominal GDP. Section A.2 provides further details on sources and variable definitions including all economic and political controls added in columns 5 and 7.

Some readers, however, might worry that our measure of program size still suffers from endogenetiy problems despite the fact that we addressed the nonrandom selection of countries into an IMF program. We therefore re-run our baseline regression while also instrumenting our measure of program size. Table 3 shows the results (see column (3)). For the sake of comparison, the baseline results from Table 1 and Table 2 are again displayed. As before, we report the first stage in the bottom panel. The IV for program size is positive and statistically highly significant. Individual access limits thus help to explain a significant part of the variation in actual access decisions. Since we have now two endogenous regressors, different thresholds for detecting weak instruments using the first-satge F-statistic apply. The Kleibergen-Paap (K-P) F-statistic testing for weak identification is about 6 and thus above the threshold of 4.58 proposed by Stock and Yogo (2005) if we are willing to tolerate a bias that is up to 15% of the worst-case bias.[18]

[18]The proposed threshold for tolerating a maximum bias of 10% in the case of two endogeneous regressor and two instruments is 7.03 (Stock and Yogo (2005)). Note that this value corresponds to the aformentioned threshold of 16.38 in the case of one exactly identified endogenous regressor.

Table 3: Aggregate Capital Inflows - Effect of Program Size

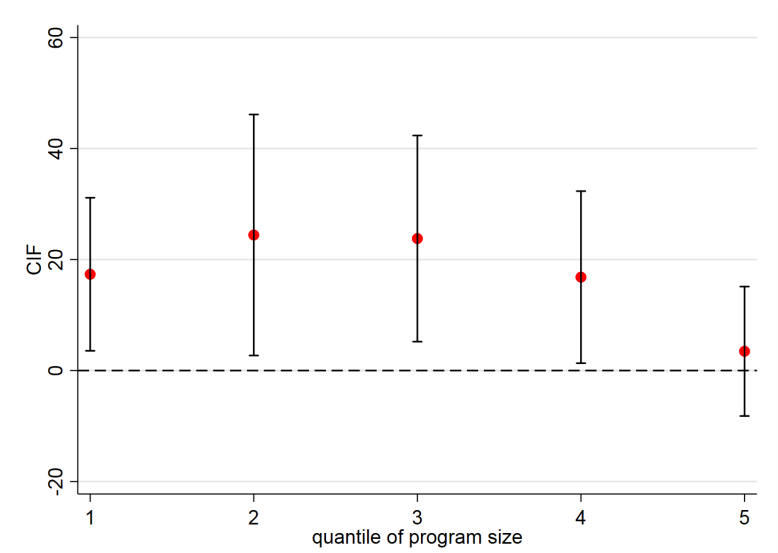
Estimation Method	IV (1)	IV (2)	IV (3)
IMF program	33.463**	34.557**	28.589*
	(16.877)	(16.481)	(15.528)
Access (in % of GDP)		-4.104**	
		(2.079)	
Access (in % of GDP), instrumented			-5.865*
			(3.181)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls (t-1)	Yes	Yes	Yes
Observations	1,550	1,550	1,550
First stage results			
IMF liquidity × IMF probability	-0.410***	-0.400***	-0.381***
	(0.087)	(0.058)	(0.092)
IMF probability	2.864***	2.417***	2.885***
	(0.441)	(0.331)	(0.413)
Access limit	-	-	0.345***
			(0.101)
K-P underidentification LM-statistic	12.197	17.558	7.001
K-P underidentification p-value	0.001	0.000	0.001
K-P weak identification F-statistic	22.496	48.196	5.988
Anderson-Rubin test p-value	0.028	0.028	0.0239

Sources and notes: robust and clustered standard errors in parentheses. IV regressions. ***Significant at 1%; **significant at 5%; *significant at 10%. In column (3), the Anderson-Rubin test displays the p-value of a test with $H_0 : \beta_{access} = 0$ under the assumption that $IMFprogram$ is strongly identified (weak-instrument-robust inference). The dependent variable is the country's gross capital inflows by foreigners (CIF), measured as changes in liabilities of the reporting country's residents held by foreign nationals. Access to IMF resources under a Fund-supported program is measured as the total amount approved relative to the country's nominal GDP. Section A.2 provides further details on sources and variable definitions including on all economic and political controls added in all specifications.

Moreover, the Anderson-Rubin test rejects the null that our estimated coefficient of program size is equal to zero at the 5%-level. The second stage of this regression shows that our coefficients of interest remain significant. These findings provide additional evidence that larger programs weaken the catalytic effect of IMF lending and can eventually even reverse it. According to these estimates, programs with access to IMF resources above 5 percent of GDP would actually lead to a negative catalytic effect. We consider this range to be quite plausible not least given that it corresponds to the right tail of the distribution of access levels observed over the past decades (see Figure 1b).

While the theoretical framework outlined in Section 3 suggests a non-linear relationship of program size and the catalytic effect, the empirical specifications estimated so far would point to a linear relationship (see Table 3). We remain agnostic about the precise functional form of the relationship of program size and the catalytic effect but try to shed further light on this issue by constructing a categorical variable of program size. More specifically, we separate the sizes of IMF arrangements into five different quantiles and test whether the (average) effect of program size differs along its distribution. In line with the predictions of our theoretical framework, the results displayed in Figure 6 would suggest that at the lower end of the distribution of past IMF arrangement sizes larger IMF financing increases the catalytic effect, while this positive effect reverses if program size is getting too large. The estimated average catalytic effect of programs in the highest quantile (with an average program size of 8.6 percent of GDP) is almost zero and potentially even negative.

Figure 6: Average catalytic effect for different IMF arrangement sizes



Sources and notes: Estimated average catalytic effect of IMF programs for different quantiles of IMF arrangement sizes. The point estimates (red dots) and respective 10-percent confidence intervals are the results of five separate regressions of our baseline specification (column (7) in Table 1) where we add a respective dummy for different quantiles of program size. The estimates thus correspond to the average catalytic effect for programs belonging to a different quantile in terms of program size. The average program size in our five different quantiles (from 1-5) is 0.4, 1.0, 1.8, 3.2, and 8.6 percent of GDP.

Turning to the *channels* through which larger programs weaken the catalytic effect, we run our baseline regression from column (3) for the different components of gross capital inflows. Given the aforementioned possible crowding-out effect of a senior creditor, we would expect our results to be mainly driven by debt-type inflows. The results in Table 4 show that this is indeed the case. The last column shows that IMF programs tend to catalyze mostly debt-type inflows while larger amounts of IMF credit weaken this effect. The estimated effect of program size on equity-inflows is neglibly small and statistically insiginificant.[19] We interpret this as further evidence that the negative effect of program size on the catalytic function is mainly due to the resulting large liabilities vis-à-vis an official senior creditor which can lead to a crowding out of private investors by increasing their loss in the event of default.

Table 4: Different Types of Capital Inflows - Baseline Specification

Type of Inflow	FDI	PILe	Debt
	(1)	(2)	(3)
IMF program	8.479	-0.082	20.701*
	(8.152)	(0.420)	(10.832)
Access (in % of GDP), instrumented	-0.289	-0.040	-5.564*
	(0.802)	(0.072)	(2.880)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls (t-1)	Yes	Yes	Yes
Observations	1,547	1,515	1,518

Sources and notes: robust and clustered standard errors in parentheses. IV regressions. ***Significant at 1%; **significant at 5%; *significant at 10%. The dependent variables are the different components of the country's gross capital inflows by foreigners, measured as changes in liabilities of the reporting country's residents held by foreign nationals. The debt component is computed as the sum of portfolio debt liabilities and other investment liabilities. Access to IMF resources under a Fund-supported program is measured as the total amount approved relative to the country's nominal GDP. Section A.2 provides further details on sources and variable definitions including on all economic and political controls added in all specifications.

We further corroborate this conclusion by using our sample to replicate the baseline regression of Gehring and Lang (2018) which explores the effect of IMF programs on the creditworthiness of a country proxied by its respective rating. We follow Gehring and Lang (2018) and use a country's S&P long-term foreign currency rating as a dependent variable. Column(1) shows that we also do not find evidence for a negative IMF program effect on a country's creditworthiness. The point estimate indicates a statistically insignificant relationship. This finding remains robust to an inclusion of our meausre of program size (which we again instrument). At the same time, column (2) shows a negative and statistically highly significant effect of program size on a country's rating. In our view, these results are consistent with those from Gehring and Lang (2018) who find evidence of a positive signal conveyed by the IMF's presence that can potentially serve as a 'cushion' against falling creditworthiness, despite contractionary adjustments related

[19] In contrast to some previous research (e.g., Breen and Egan (2019)), we also do not find evidence of a generally negative effect of IMF lending on FDI.

to the program. This notwithstanding, rating agencies conduct a holistic assessment of credit risk which includes both the probability of default and the loss given default. While the former is likely to be lowered by the presence of an IMF program (see, for instance, Balima and Sy (2019)), the latter would increase with the size of a program. This could explain the negative estimated effect of program size on sovereign ratings and could be viewed as additional evidence for the presence of a crowding-out effect of a large senior creditor.

Table 5: Effect on Sovereign Ratings - Controlling for Program Size

Estimation Method	IV	IV
	(1)	(2)
IMF program	-0.901	-0.300
	(1.485)	(2.171)
Access (in % of GDP), instrumented		-1.085***
		(0.419)
Country FE	Yes	Yes
Year FE	Yes	Yes
Controls (t-1)	No	No
Observations	2,049	2,049

Sources and notes: robust and clustered standard errors in parentheses. IV regressions. ***Significant at 1%; **significant at 5%; *significant at 10%. Column (1) replicates the baseline specification of Gehring and Lang (2018) using our slightly different sample. Column(2) adds program size as an additional (endogenous) regressor. The dependent variable is the S&P long-term foreign currency ratings obtained from their website and converted to a numerical scale following Gehring and Lang (2018).

4.4 Robustness

This section presents several robustness checks for our main findings. We focus on our baseline specification as displayed in Table 3, column (3). As a first step, we exclude euro area program countries (i.e., Cyprus, Greece, Ireland, and Portugal) from our sample. With the exception of Cyprus, all of these programs entailed exceptional access to Fund resources. Moreover, all of them were accompanied by large-scale official financing from other euro area member states (either through bilateral loans or through the EFSM, EFSF, or later ESM). At the same time, these programs were peculiar in a sense that these countries did not have a financing need in foreign currency and all countries were part of a currency union. As can be seen from the first column in Table 6, however, our baseline results do not seem to be driven by these particular programs. Another possible concern regarding the robustness of our results might be that we also include programs which were treated as precautionary such that approved funds were actually not being drawn upon. These programs typically aim at giving a seal of approval by the IMF to countries that typically do not face an imminent crisis. It could be argued that the catalytic effect of these programs should be stronger. Column (2) thus shows the results of our baseline regression if we exclude all precautionary arrangements. As can be seen, our results remain basically unchanged. Next, we test whether our findings are influenced by

the extent to which countries comply with IMF policy conditions that are attached to a program. If IMF programs worked mainly through the influence that conditionality exerts on economic policies, we would expect a failure to meet the conditions laid out in the lending agreement (i.e., 'bad' program performance) to weaken the catalytic effect (see, for instance, Edwards (2006) or Jorra (2012)). We address this problem by augmenting our estimation equation with an indicator that takes the value 1 if a country was compliant with its IMF program.[20] While theoretically convincing, the distinction between 'good' and 'bad' program performance seems to be less important for our empirical results (see column (3)). Despite the generally different nature of PRGT-programs, we include all PRGT-eligible countries and blended arrangements (i.e., all programs where a country simultaneously had a program under the GRA and the PRGT, respectively.) As column (4) shows, our results are robust to such an approach. In column (5), we add a measure of the degree of frontloading of a program. Specifically, we add the share of the amount disbursed in the first half year of the program relative to the overall amount approved. We adjust for program length by multiplying the respective share with the number of half year periods the program lasts. Again, our results regarding the effect of program size remain unchanged. The point estimate regarding the general effect of an IMF program also remains in a similar range, while the coefficient is just rendered insignificant. However, this could be explained by a high degree of multicollinearity between frontloading and the presence of a program which makes it difficult to empirically disentangle all the different effects which potentially work through various channels. This is corroborated by the fact that we also do not find a significant effect of frontloading on capital flows. At the same time, this could also be due to the fact that a strongly frontloaded disbursement schedule might entail countervailing effects. On the hand, it could strengthen the coordination effect by providing upfront liquidity and by signalling that the IMF is confident that its involvement will be effective. On the other hand, it might weaken the incentives for the government to implement adjustment measures in the later part of the program which would in turn weaken the signalling effect of a program. As a result, these two countervailing effects might actually cancel each other out. Finally, we take as an alternative for our first component of the instrumental variable (i.e., $IMFprobability$), a time-invariant, country-specific measure instead of the cumulative, time-variant probability (see also Gehring and Lang (2018)). Taking all observations in the sample period into account considers observations from future periods (i.e., $t+1$, $t+2$ etc.) to compute the probability in t. Although this could well be deemed as conceptually problematic, column (6) shows that our estimates are not materially affected by this modification.[21]

Another possible concern regarding our identification strategy relates to the construction of the quota formula of the IMF. The current formula includes a measure of capital flow variability which is intended to capture member's potential need for Fund resources. Countries with a higher quota (and thus potentially larger access to Fund resources) might

[20] Similar to Dreher and Walter (2010) and Jorra (2012), we code a program as not suffiently complied with when more than 20% of the credit amount agreed under an IMF program remains undrawn at program expiration.

[21] In addition to these robustness checks, we proxy for different purposes of IMF programs by adding covariates such as the (lagged) level of international reserves (measured in months of imports), the fiscal balance as well as public debt. Moreover, we control for the possibility that the catalytic effect is different for IMF arrangements with democratic countries. All our general results remain more or less unchanged and are not reported for the sake of brevity.

thus be particularly prone to balance of payments crises. However, we would argue that this does not constitute a concern for our analysis for the following reasons: First, the variability measure only has a small weight in the quota formula. Second, there is an ongoing discussion at the Fund whether to even drop this variable from the quota formula as "empirical analysis suggested that the existing variability measure, even when adjusted for economic size, is virtually uncorrelated with use of IMF resources" (IMF (2013), p. 26). Lastly, we add as a further control variable a measure of trade openness which is another quota formula variable highly correlated with the variability measure (cf. IMF (2013), p. 18) and which might in addition capture a country's capacity to service its external debt. All our results remain unchanged and are therefore not reported for the sake of brevity.

5 Conclusion

The success of an IMF program hinges to a large extent on its catalytic effect, that is, its ability to increase the propensity of private investors to hold financial assets in the country concerned. An extensive literature has therefore emerged investigating the existence of the catalytic function as well as the appropriate conditions which have to be in place in order for private capital flows to behave like 'bedfellows' of official financing. So far, the empirical evidence on the presence of such a catalytic effect of IMF lending has been mixed. In most of these previous studies, the role of the amount of financing provided by the IMF has, however, been subject to limited scrutiny. At the same time, it is quite conceivable that too much official financing by a senior creditor such as the IMF weakens the catalytic effect of a program by increasing the loss given default for private creditors, which are junior to the Fund. Not least in light of the fact that the average size of IMF arrangements has increased and larger arrangements have been agreed more frequently over time, understanding the effects of large volumes of IMF lending becomes all the more relevant.

In this paper, we study the catalytic effect of IMF lending from a gross flows perspective and provide evidence that the catalytic effect of IMF financial assistance is weakened - and potentially reversed - if the size of a program exceeds a certain level. According to our estimates, a generally positive catalytic effect would be reversed once the amount of IMF financing is above 5 percent of GDP. This threshold corresponds to the right tail of the actual distribution of programs approved over the last decades. We show that this effect is mostly driven by a reduction of debt-type capital inflows of foreign residents which supports our conjecture of an eventual crowding-out effect owing to the Fund's preferred creditor status. Our findings add to the debate on the optimal size of Fund-supported programs and can also inform the broader policy discussions on the adequacy of IMF resources and the effectiveness of IMF programs in helping its members to solve their balance of payments crisis.

Table 6: Various Robustness Tests

	excl. EA program countries (1)	excl. precautionary programs (2)	control for compliance (3)	incl. PRGT (4)	control for frontloading (5)	constant probability (6)
IMF program	28.927*	32.527**	33.296*	28.265*	22.894	24.005*
	(16.725)	(16.548)	(18.477)	(16.266)	(16.051)	(13.686)
Access	-6.490*	-7.028*	-6.622*	-7.007*	-7.307**	-5.636*
	(3.484)	(3.799)	(3.482)	(3.658)	(3.725)	(3.163)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls (t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,508	1,448	1,530	1,637	1,530	1,530

Sources and notes: robust and clustered standard errors in parentheses. IV regressions. ***Significant at 1%; **significant at 5%; *significant at 10%. The dependent variable is the country's gross capital inflows by foreigners (CIF), measured as changes in liabilities of the reporting country's residents held by foreign nationals. Access to IMF resources under a Fund-supported program is measured as the total amount approved relative to the country's nominal GDP. The sample contains up to 103 countries and covers the 1990 to 2018 period. Section A.2 provides further details on sources and variable definitions including on all economic and political controls added.

A Appendix

A.1 Derivation of formal results

A.1.1 Equilibrium conditions

The derivation closely follows Corsetti et al. (2006). Let us start by deriving the equations that determine $\bar{R}$ and $\bar{R}_L$. Recall that the fraction of investors who withdraw in the interim period is denoted by x and depends on the realization of R. Given that those who withdraw is the proportion of investors who receives a private signal below the critical value s^*, the fraction x is given by

$$x = prob(s_i \leqslant s^* | R) \equiv G(s^* - R). \tag{25}$$

This can now be used to derive an expression for $\bar{R}$. From equation (6) we know that, if the IMF does not intervene, the country defaults when $R \leqslant \bar{R}$. At $R = \bar{R}$, the mass of international investors who withdraw is just sufficient to cause a default of the country. This mass is given by $G(s^* - \bar{R})$. Plugging this into equation (6), we can define the first equilibrium condition for $\bar{R}$ as

$$\bar{R} = R_s \left[1 + \kappa \frac{[G(s^* - \bar{R}) \cdot D - M]}{D - M} \right]. \tag{26}$$

Turning to the case where there is an IMF intervention, the country will be in a crisis for any R such that $R \leqslant \bar{R}_L$. Again, the critical mass neccessary to cause a default is $x = G(s^* - \bar{R}_L)$.
Using equation (8), we get the threshold for failure conditional on IMF intervention, i.e.,

$$\bar{R}_L = R_s \left[1 + \kappa \frac{[G(s^* - \bar{R}_L) \cdot D - M - L]}{D - M} \right]. \tag{27}$$

As mentioned before, the solvency threshold that is relevant for the IMF's decision is different to that of the private investor because of its preferred creditor status. The critical mass of speculators to cause debt liquidity-related problems that end up in a default of IMF loans is higher and given by $G(s^* - \bar{R}_{IMF})$. Using equation (11), we thus obtain

$$\bar{R}_{IMF} = R_s \left[(1 + \kappa) \frac{[G(s^* - \bar{R}_{IMF}) \cdot D - M]}{D - M} - \kappa \frac{L}{D - M} \right]. \tag{28}$$

What is left are the two equations determining the optimal triggers s^* and S^*. The IMF receives its signal $\tilde{S}$ and assigns a probability $H(\bar{R}_{IMF} - S)$ to the failure of the country to repay at least IMF loans in period 2 despite its intervention in the interim period. The IMF expected payoff ($\mathscr{W}_{IMF}$) is therefore

$$\mathscr{W}_{IMF} = B \cdot (1 - H(\bar{R}_{IMF} - S)) - C \cdot H(\bar{R}_{IMF} - S). \tag{29}$$

where the constants B and C are meant to capture the respective benefits and costs of providing liquidity (cf. Corsetti et al. (2006), p. 448). The IMF is allowed to lend to the

country if and only if the expected payoff is non-negative. This is the case as long as $S \geqslant S^*$, where S^* is defined by

$$S^* = \bar{R}_{IMF} - H^{-1}\left(\frac{B}{B+C}\right). \tag{30}$$

The last equilibrium condition determines the optimal trigger for private international investors, i.e., s^*. The investor has to consider more possible outcomes than the IMF. Independent of IMF intervention, the country will default on private loans for any R such that $R \leqslant \bar{R}_L$. Upon receiving a signal $\tilde{s}$, the investor assigns a probability $G(\bar{R}_L - s)$ to the event 'default regardless of the IMF's action'. At the same time, the country will only default for R comprised between $\bar{R}_L$ and $\bar{R}$ if the IMF fails to intervene. Hence, the payoff function of private investors ($\mathscr{W}_{PI}$) includes a term that accounts for the conditional probability that the IMF fails to provide liquidity to the country, which is denoted by $H(S^* - R)$. Hence, the payoff function is determined by

$$\begin{aligned}\mathscr{W}_{PI} =& b\left[1 - \left(G(\bar{R}_L - s) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^*-R)dR\right)\right] \\ &- c\left(G(\bar{R}_L - s) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^*-R)dR\right),\end{aligned} \tag{31}$$

where $g(\cdot)$ is the probability density function and the constants b and c capture the respective benefits and costs of lending to the country. As usual, the optimal trigger s^* for international investors is implicitly defined by the zero-profit condition (in expected terms). Hence, from equation (18) it follows that

$$\frac{b}{b+c} = G(\bar{R}_L - s^*) + \int_{\bar{R}_L}^{\bar{R}} g(R-s)\cdot H(S^*-R)dR \tag{32}$$

As shown by Corsetti et al. (2006), there is a unique value s^* that solves this equation. The five equations (26)-(28), (30) and (31) in five endogenous variables ($\bar{R}$, $\bar{R}_L$, $\bar{R}_{IMF}$, S^*, and s^*) completely characterize the equilibrium.

A.1.2 Marginal effect of L

This appendix shows the derivation of equation (18) (see Corsetti et al. (2006), pp. 465). Differentiating equations (12), (13), and (14) and rearranging, we get

$$\frac{ds^*}{dL} = \left(1 + \frac{1 - M/D}{R_s \cdot \kappa \cdot g(s^* - \bar{R})}\right)\cdot \frac{d\bar{R}}{dL}, \tag{33}$$

$$\frac{ds^*}{dL} = \left(1 + \frac{1 - M/D}{R_s \cdot \kappa \cdot g(s^* - \bar{R}_L)}\right)\cdot \frac{d\bar{R}_L}{dL} + \frac{1}{g(s^* - \bar{R}_L)}. \tag{34}$$

$$\frac{ds^*}{dL} = \left(1 + \frac{1 - M/D}{R_s \cdot (1+\kappa) \cdot g(s^* - \bar{R}_{IMF})}\right)\cdot \frac{d\bar{R}_{IMF}}{dL} + \frac{\kappa}{(1+\kappa)}\cdot\frac{1}{g(s^* - \bar{R}_{IMF})}. \tag{35}$$

We define ζ_1, ζ_2, and ζ_3 as follows

$$\zeta_1 = \left(1 + \frac{1 - M/D}{R_s \cdot \kappa \cdot g(s^* - \bar{R})}\right)^{-1},$$

$$\zeta_2 = \left(1 + \frac{1 - M/D}{R_s \cdot \kappa \cdot g(s^* - \bar{R}_L)}\right)^{-1},$$

$$\zeta_3 = \left(1 + \frac{1 - M/D}{R_s \cdot (1+\kappa) \cdot g(s^* - \bar{R}_{IMF})}\right)^{-1}.$$

Note that $\zeta_1, \zeta_2, \zeta_3 \in (0, 1)$. Following Corsetti et al. (2006), we apply a change of variables and define $w = R - s^*$, $\bar{w} = \bar{R} - s^*$, $\bar{w}_L = \bar{R}_L - s^*$ and $\bar{w}_{IMF} = \bar{R}_{IMF} - s^*$. Using (33), (34), and (35) we have

$$\frac{\bar{w}}{dL} = -(1 - \zeta_1)\frac{ds^*}{dL}, \tag{36}$$

$$\frac{\bar{w}_L}{dL} = -(1 - \zeta_2)\frac{ds^*}{dL} - \frac{\zeta_2}{g(\bar{w}_L)}, \tag{37}$$

$$\frac{\bar{w}_{IMF}}{dL} = -(1 - \zeta_3)\frac{ds^*}{dL} - \frac{\kappa}{(1+\kappa)} \cdot \frac{\zeta_3}{g(\bar{w}_{IMF})}. \tag{38}$$

Changing also variables in equation (16) and using (15) we have

$$\frac{b}{b+c} = G(\bar{w}_L) + \int_{\bar{w}_L}^{\bar{w}} g(w) \cdot H\left(\bar{w}_{IMF} - w - H^{-1}\left(\frac{B}{B+C}\right)\right) dw \tag{39}$$

Differentiating (39) and rearranging terms:

$$\frac{d\bar{w}}{dL}\zeta_4 + \frac{d\bar{w}_L}{dL}\zeta_5 + \frac{d\bar{w}_{IMF}}{dL}\zeta_6 = 0 \tag{40}$$

where:

$$\zeta_4 = g(\bar{w}) \cdot H\left(\bar{w}_{IMF} - \bar{w} - H^{-1}\left(\frac{B}{B+C}\right)\right) > 0 \tag{41}$$

$$\zeta_5 = g(\bar{w}_L) \cdot \left[1 - H\left(\bar{w}_{IMF} - \bar{w}_L - H^{-1}\left(\frac{B}{B+C}\right)\right)\right] > 0 \tag{42}$$

$$\zeta_6 = \int_{\bar{w}_L}^{\bar{w}} g(w) \cdot h\left(\bar{w}_{IMF} - w - H^{-1}\left(\frac{B}{B+C}\right)\right) dw > 0 \tag{43}$$

Using (36), (37), and (38) this yields:

$$\frac{ds^*}{dL} = -\frac{\frac{\zeta_2\zeta_5}{g(\bar{w}_L)} + \frac{\zeta_3\zeta_6\kappa}{g(\bar{w}_{IMF})(1+\kappa)}}{[\zeta_4(1-\zeta_1) + \zeta_5(1-\zeta_2) + \zeta_6(1-\zeta_3)]} < 0. \tag{44}$$

A.2 Sources and description of the variables

Dependent variables

The source of countries' gross capital flows and their components (FDI, portfolio equity and debt, other capital flows) is the dataset developed by Broner et al. (2013) which has been extended with Balance of Payments data from the IMF. Data from Broner et al. (2013) is available at https://datacatalog.worldbank.org/dataset/wps5768-gross-capital-flows-data-files. The IMF's Balance of Payments data can be accessed at http://data.imf.org/BOP.

The dependent variables are expressed as ratios to nominal GDP obtained from the World Bank's World Development Indicators (WDI), which can be accessed at https://data.worldbank.org/indicator/ny.gdp.mktp.cd.

The rating variable is the S&P long-term foreign currency ratings obtained from their website and converted to a numerical scale following Gehring and Lang (2018).

Independent variables

IMF Program

Our indicator on whether a country had an IMF program in a certain year was constructed with data from the IMF's website and various program documents.

Program Size

Data on access to Fund resources was obtained from the IMF's website and various program documents, and the MONA database. Generally, if a country had more than one arrangement in a given year, the more recent program was treated as the relevant arrangement.[22]

Real GDP growth

Real GDP growth has been obtained from the IMF's International Financial Statistics (IFS, https://data.imf.org/IFS).

Investment rate

Countries' gross fixed capital formation in percent of GDP obtained from the World Bank's WDI (https://data.worldbank.org/indicator/ne.gdi.ftot.zs).

[22]Two exceptions are India (1991), where two subsequent programs beginning in the same year are treated as one program and Argentina (2003), where the program from January to August is considered as the relevant one for the year 2003 and the program starting in September 2003 is treated as starting in January 2004 only.

Chinn-Ito index

An index measuring a country's degree of financial account openness as initially introduced by Chinn and Ito (2006). Source: http://web.pdx.edu/~ito/Chinn-Ito_website.htm.

Lending interest rate differential

Interest rate differentials vis-à-vis the United States have been calculated based on lending interest rate data from the IMF's IFS (https://data.imf.org/IFS).

Exchange rate volatility

A measure of exchange rate volatility constructed from monthly nominal USD exchange rate data obtained from the IMF's IFS (https://data.imf.org/IFS) by dividing the annual variance by the yearly mean of the exchange rate.

Institutional quality index

The institutional quality index is the overall political risk index from the International Country Risk Guide (ICRG) surveys, published by the PRS group. The index ranges from zero to one and includes 12 weighted variables covering both political and social attributes.

Crisis dummies

Yearly dummies for systemic banking crises, currency crises, and sovereign debt crises have been constructed from the dataset developed by Laeven and Valencia (2018), considering only the first year of a systemic banking crisis as a crisis year.

Instrumental variables

Bartik shift-share instrument for IMF program

The instrument for $IMFprogram$ is an interaction of backward-looking IMF probability (the share of years with IMF program since 1967) and the IMF's one-year Forward Commitment Capacity (FCC) as shift variable. The FCC is a measure of the resources available to the Fund for new financial commitments obtained from individual IMF Annual Reports.

Access limits

Countries' access limits were calculated by multiplying countries' historical IMF Quotas with historical cumulative quota-based access limits. Quotas were accessed at the country-specific IMF websites and the cumulative access limits are taken from IMF documents on the regular reviews of access limits. Access limits are expressed in percent of nominal GDP, which has been obtained from the World Bank's WDI (see above).

Table A1: Descriptive statistics: Baseline Sample.

	Mean	p25	Median	p75	SD
Gross capital inflows	9.23	2.25	5.65	10.12	37.36
FDI inflows	4.46	1.11	2.56	4.80	17.59
Portofolio equity inflows	0.41	0.00	0.02	0.51	2.10
Debt inflows	4.36	-0.06	2.37	5.60	28.90
IMF program	0.29	0.00	0.00	1.00	0.45
Access	3.15	0.97	1.92	4.09	3.24
Access limit	5.16	2.83	4.03	6.19	3.76
FCC	155.06	71.88	89.03	198.97	123.23
IMF probability	0.28	0.00	0.24	0.47	0.26
Real GDP growth	4.08	2.06	3.95	6.07	4.73
Investment rate	23.38	19.58	22.41	26.13	6.02
Financial account openness	0.62	-1.20	1.07	2.36	1.52
Institutional quality	70.18	62.42	70.25	78.08	10.79
Interest differential	13.35	1.39	5.35	12.28	122.20
Exchange rate volatility	2.13	0.00	0.01	0.09	31.13
Banking crisis	0.03	0.00	0.00	0.00	0.16
Currency crisis	0.03	0.00	0.00	0.00	0.16
Debt crisis	0.01	0.00	0.00	0.00	0.08

Notes: The baseline sample (without any controls) consists of 2,444 observations. Given limited data availability for a number of cases, the number of observations reduces once we add the covariates.

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